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E-procurement and E-supply Chain: Features and Development of E-collaboration

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Abstract

The opportunity offered by digital technologies to make deep rationalization in purchase of supplies is becoming indispensable in competition between enterprises, considering positive effects in reducing the costs of the companies that have adopted the E-Procurement. As it has been confirmed by numerous case studies, automation of procedures for the purchase through e-procurement technology enables companies to achieve a reduction in costs (average 8-12%) of total purchases. So web-based models are playing a critical role within companies, especially in the generation of value of supply chain. This article focuses on the role of e-procurement within a supply chain showing, through simulations, the advantages and difficulties of implementing a systematic use of the Internet and defining the basic structure of an e-supply chain.

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Keyword: E-procurement; E-supply chain; supply chain management; purchasing; internet

1. Introduction

Technological innovation in the supply chain has become very important, allowing improvements, in terms of efficiency and quality, in the management of physical, information and financial flows. In addition to productivity gains, extremely significant are the changes that technological innovation achieves in the

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structure of relationships between suppliers, manufacturers, distributors, intermediaries, customers and in the strategic choices of firms. In particular, in a competitive environment where the main resource is represented by the information, a crucial role is played by technologies that facilitate their acquisition, their use and their management.

2. Literature review

This paragraph presents an overview of the literature aimed at identifying both the most common definitions of e-procurement (EP). The literature on this topic started to appear in the nineties. Van Weele (1994) defines e-procurement as the use of Internet technology in the process of providing goods and services. According to de Boer, Harink and Heijboer (2002), EP can be defined as using the Internet in the purchasing process. In a similar way Presutti (2003) defines EP as a technology solution that facilitates corporate buying using the Internet and Knudsen (2003) emphasizes the capability of electronic commerce to enhance the procurement process.

In recent years, many authors have focused their studies on the evolution of the web-based systems in the supply chain with a focus on growth, development and expected trends related to the implementation of a platform for e-procurement. Leonard and Spring (2002) define EP as a model of strategic purchasing.More specifically, Balocco and Rangone (2002) provide a description of the role of e-marketplaces and B2B applications, focusing their discussion on the various models and tools for interaction based on the use of the internet.

Previously, Monczkaand Trent (1998) had analyzed the functional value of the management of purchases for the determination of the performance and competitive position of an organization in its business area, and the reasons for the increase of interest in the purchasing area. In the same year, Ken Kenjale and Arnie Phatak(2002) highlight how the Exchange B2b can create value chains that reduce costs for both the buyer and for the supplier side, and how these tools align better the supply chain to customer needs.

In 2003, the observatory research on B2B of “Politecnico di Milano” provides a set of tools that allow us to qualitatively assess the levels reached in the management of transactions. Finally, in 2003, Bertelè and Rangone provide the measure of the development of e-supply chain and e-collaboration, highlighting the strengths, critical points for a correct and functional implementation and expected future trends (Bertelè and Rangone, 2005).

3. E-procurement and E-supplychain

The adoption of technological solutions involves both organizational changes and reengineering of processes. The use of B2B tools provides a new role to management, who can spend more attention to strategic activities with greater added value. The traditional mode of acquisition is changed going from centralized to decentralized and this leads to a fundamental change in the role of employees in purchasing. Table 1 shows a summary of the evolution of the purchasing function following the adoption of tools for e-procurement. This change is proportional to the intensity with which company uses the electronic market. The management will have to develop the rules that define the relationship between suppliers and customers. A new corporate figure, will have to design tools for decision making that allows employees to set the criteria for purchase. So, these tools provide support and supervision in the purchase phase and an integrated view of the process.

E-Procurement is defined as "a technology solution that facilitates corporate buying using the Internet" (Presutti, 2003). It 'a set of e-businesses and e-solutions that support the buying process. In this specific case,

the focus along the chain moves from downstream, and then from the last links in the chain, to upstream, directly in contact with the supply network.

With e-procurement the entire procurement process is handled online, so the company decided to make the purchases of various types, from raw materials to services, using B2B systems: these tools allow enterprises to reduce the cost and time of the procurement process, improve inventory and stocks management and, consequently, this is reflected in a decisive improvement in the management of all business processes. This is a necessary solution for large companies because it makes easier and more effective the management of the entire process of purchasing and supply network, and, on the other hand, for smaller companies that, in adopting e-procurement solutions, can become part of a global business with many opportunities for growth.

The entire process of Procurement involves a series of processes of implementing as well as series of evaluations on strategic choice. The entire process of e-Procurement is then divided into two phases:the phase of e-sourcing and the phase of e-Supply Chain Management.

The e-supply chain is the series of processes involving a company and its main partners, managed in an integrated manner with the potential of new technological solutions that allow the planning of processes and objectives and the sharing of information relevant for the entire chain. In order to understand in detail the characteristics of e-supply chain, it can be adopted an analytical model based on two variables interpretative:

- the application environment which includes the processes of e-supply chain execution and collaboration;
- the technological choices of the company.

4. The simulation model

The aim of thispaper was to study and analyze the behavior of the variables of a simulation model under certain conditions. The model of e-collaboration, through implementation of e-procurement system, allows to speed up the flow of supply, making the process of order release.

4.1. Setting used: stock and flow

The model developed simulates the behavior of a real manufacturing system that operates in a make-to-order environment. The purpose of the simulation is to analyze the behavior of the system following the implementation of a model of e-collaboration, in terms of reduction of costs related to financial assets and penalties. The production system described is composed of two chains of events: order picking in warehouse, purchase orders.Purchase orders are characterized by an emission time that varies according to the number of positions, of the amount and the monetary value of purchase orders. After the order release and the subsequent shipment, the materials are in stock to be picked up.

In order to reduce the costs of inventory management is necessary that the materials are available from stock in time for the date of picking. Generally pick orders depend on the configuration of bills of materials (change board) that in case of variation require the release of new purchase orders (purchase orders subject to change board).In this context it is necessary to differentiate temporally the two chains of events in order to avoid the two situations described below:

- materials are available from stock in advance of the date of picking (increase in the cost of storage);
- materials are not available for picking (increase in the cost of penalties).

In the modeling process were analyzed two alternative approaches:

1. Model-based correlation of time series containing: number of orders released each year, number of late orders each year, average delay.

2. Model based on aleatory variables limited superiorly and inferiorly.

It was decided to investigate the second approach, which allows to simulate the variability of the phenomenon of release orders as shown in Fig. 1.

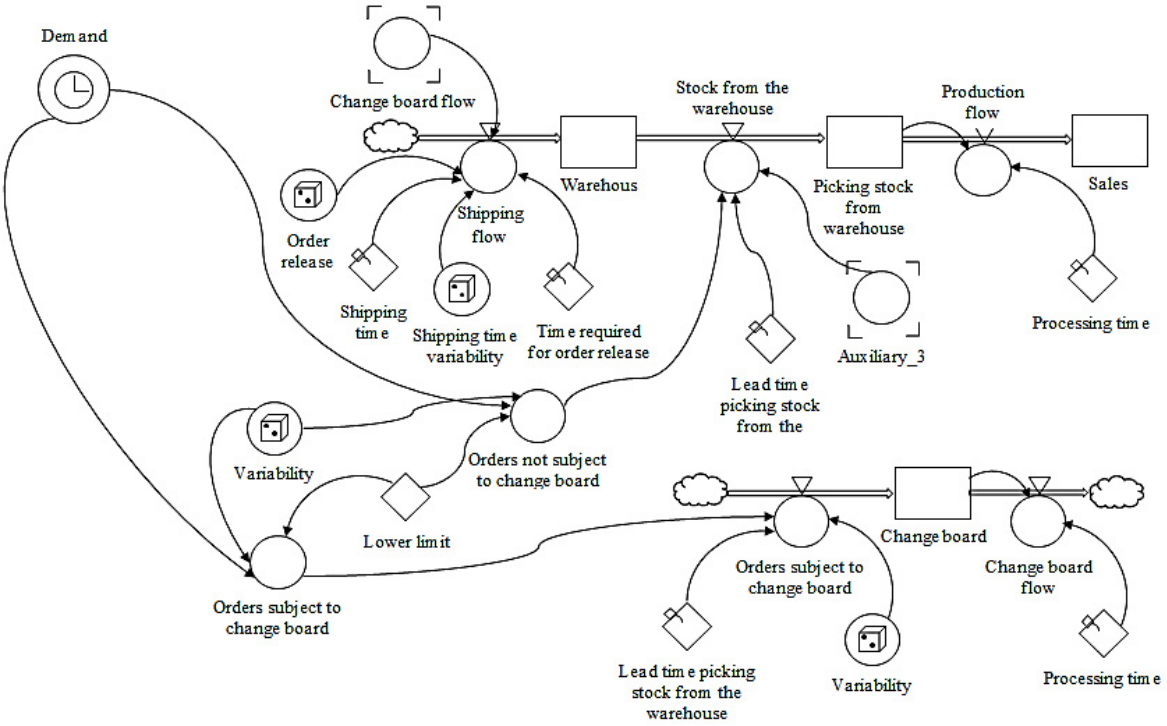

Fig. 1. Stock and flow diagram

Table 1 reports a description of the elements used in the Stock and Flow diagram.

Table 1. Parameters used in the stock and flow diagram

Name	Description	Typology
Demand	Customersdemand	Auxiliary variable
Processing/shipping time	Time required by supplier for produce and ship goods	Constant
Processing/shipping variability	Variable distributed in a specific range and different for each time step	Aleatory variable
Time required for order release	Order release time includes order definition, signature authorization and supplier confirmation	Constant
Order release variability	Aleatory variable that simulate the order release variability	Aleatory variable
Input flow	Materials input flow Flusso di ingrasso dei materiali a magazzino	Variable
Warehouse	Materials level in the warehouse	Level
Output flow	Picking rate related to orders emission	Variable
Lead time picking stock from the warehouse	Lead time	Constant
Picking time variability	Aleatory variable that considers the possible variability in the picking stock from warehouse process.	Variable
Materialspicked from warehouse	Number of pieces picked from warehouse	Level
Production flow	Work in progress materials flow	Variable
Finish products warehouse	Finished products ready to customers delivery	Level
Condition: orders subject (or not)	Changeboardphenomenoncondition	Variable

to Change board		
Change board	Change board input flow level	Variable
Orders release time with Change board	Lead time for Change board phenomenon	Constant
Change board variability	Aleatory variable	Variable
Orders subject to Change board	Orders requiring modification/new release cause Change board.	Level

The cost evaluation is carried out by analyzing the level of stock of the warehouse modified at each time step from an input and an output flow.

4.2. Structure

In this context, particular attention was given to the variables that influence the flow of input and output from the warehouse in order to identify any blinding costs related to the implementation of e-collaboration model. We assumed threesimulation scenarios: without e-collaboration, with e-collaboration and chains of events (purchase order, picking order) not phased and with the model of e-collaboration and chains of events (purchase order, picking order) phased. Furthermore, it has been referenced documents of single-position purchasing, characterized by a fixed economic value described by a step function.

The simulation scenarios are characterized by an observation period of one year and a timestep of one day, and they are influenced by the following random variables: variability time of order release, variability shipping time, variability time of picking and variability modification change board. The phenomenon of change board is simulated by a logical condition with reference to the aleatory variable named "Change Board"; in particular, the system initializes the release of a new document of purchase in case that variable takes on a value less than 0.1, exposing the stock to higher inventories. The costs analyzed are of two types:

- Cost penalties: a percentage of the value of the supply valued for each time step;
- Cost of inventory: function of average stock level and standard cost of maintenance.

5. Simulation results

The three scenarios have revealed in quantitative terms the benefits associated with the implementation of a model of e-collaboration. Comparing the first two scenarios, they show a decrease in penalties to customers and at the same time an increase in financial assets that allow firms to avoid the occurrence of subsequent penalties against a rapid change in demand. The increased speed of the process, achieved by reducing activities not value added, allows to make the system more responsive to exogenous changes.The Fig. 3a shown below represents the trend of the warehouses in the first two scenarios, Fig. 2b compare the e-collaboration scenarios with and without release time update.

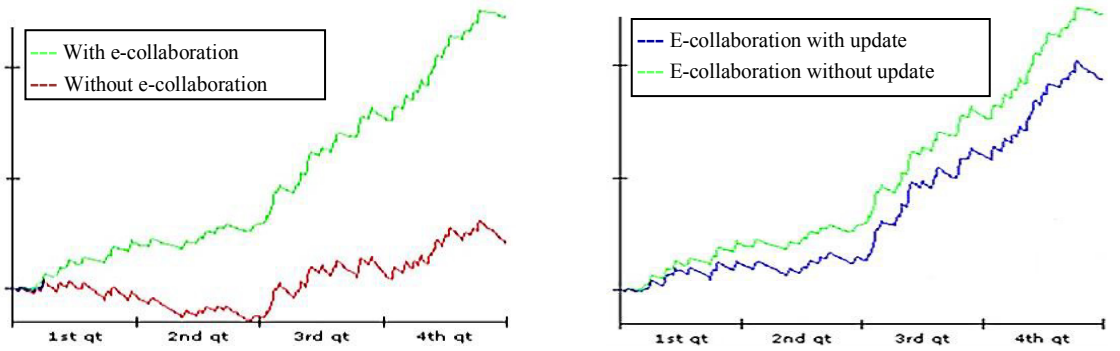

Fig. 2. (a) First scenario compared with second one; (b) Second and third scenarios compared

The saving achieved following the implementation of a model of e-collaboration is summarized in Table 2.

Table 2. Results

Scenario	Storage materials cost in warehouse [€]	Penalties cost [€]	Total [€]
Without e-collaboration	20,99	1.139,43	1.160,42
With e-collaboration (release time not up-to-date)	291,93	0,99	292,93
With e-collaboration (release time up-to-date)	185,93	6,88	192,82
Variation case2/ case 3 [€]	-106,00	5,89	-100,11
Variation case 1/ case 3 [€]	164,95	-1.145,32	1.060,31

More specifically, comparing the last two scenarios, both characterized by the adoption of the model of e-collaboration, it should be noted in the third scenario, a reduction of the total cost due to increased speed of the downstream process and this leads to a reduction of the stock of goods in stock.

6. Conclusions and future developments

The study presented has allowed us to analyze the growing interest that companies turn to web-based tools to support the supply chain. The analysis shows that the recent success of the models of e-collaboration allows various stakeholders to be more involved in the process of value creation:

- Suppliers: Collaboration between the company and its suppliers for process improvement (planning, purchasing, logistics and administration) and an integrated approach to engineering design (exchange technical documentation);
- Employees: Managing a centralized access point (portal), synthetic vision of the operations to be carried out thanks to a simple and fast access to information (push logic);
- Other Stakeholders: Availability of indicators for measuring the performance of suppliers (eg, management);
- Customers: Increase level of service received and the quality of the final product.

The strength of this solution consists in the possibility to integrate the supply chain starting from the selection process of suppliers up to the billing process. The idea is to support the entire Supplier Lifecycle integrating the business function of purchasing, logistics, quality and administration in order to be more competitive on the market.The simulation model has allowed to detect in quantitative terms the savings achievable with the adoption of a model and-collaboration. The model has shown how an enterprise can derive further benefit in terms of cost modulating the flow of picking from the warehouse, as a function of the higher speed achieved upstream of the process.

The work has analyzed some aspects of the management of a supply chain, covering warehouse management under different boundary conditions, but the work of analysis can be extended to the rest of the system.The future goal will be the implementation and validation of a model that allows to define the demand on historical data, expanding the problem to the purchase documents subject to MRP run.

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